Defining the Wildland-Urban Interface
A Logic-Graphical Interpretation

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The Healthy Forests Restoration Act solidified a relationship and responsibility to be shared between federal agencies managing public lands with ignitable vegetation, and the County governments where those lands are located.

1.1 Healthy Forests Restoration Act

On December 3, 2003, President Bush signed into law the Healthy Forests Restoration Act of 2003 to reduce the threat of destructive wildfires while upholding environmental standards and encouraging early public input during review and planning processes. The legislation is based on sound science and helps further the President's Healthy Forests Initiative pledge to care for America's forests and rangelands, reduce the risk of catastrophic fire to communities, help save the lives of firefighters and citizens, and protect threatened and endangered species.

Among other things, the Healthy Forests Restoration Act (HFRA):

- Strengthens public participation in developing high priority projects;
- Reduces the complexity of environmental analysis allowing federal land agencies to use the best science available to actively manage land under their protection;
- Creates a pre-decisional objections process encouraging early public participation in project planning; and
- Issues clear guidance for court action challenging HFRA projects.

County level Wildland-Urban Interface Wildfire Mitigation Plans are developed to adhere to the principles of the HFRA while providing recommendations consistent with the policy document which should assist the federal land management agencies (US Forest Service and Bureau of Land Management) with implementing wildfire mitigation projects that incorporate public involvement and the input from a wide spectrum of fire and emergency services providers in the region.

HFRA specifies that the responsibility of defining the boundaries of the Wildland-Urban Interface rests with the County Government and appointed Interface Interagency Committees created by the County Commissioners. In the absence of a defined Wildland-Urban Interface, the federal agencies are directed to use a fixed buffer distance from defined community centers, or in some instances, around structures. The federal agencies are directed to use the Wildland-Urban Interface definition created and approved by the Counties wherever they exist.

1.2 Wildland-Urban Interface

1.2.1 People and Structures

A key component in meeting the underlying need is the protection and treatment of fire hazard in the wildland-urban interface. The wildland-urban interface refers to areas where wildland vegetation meets urban developments, or where forest fuels meet urban fuels (such as houses). These areas encompass not only the interface (areas immediately adjacent to urban development), but also the continuous slopes and fuels that lead directly to a risk to urban developments. Reducing the fire hazard in the wildland urban interface requires the efforts of federal, state, local agencies, and private individuals. "The role of [most] federal agencies in the wildland urban interface includes wildland fire fighting, hazard fuels reduction, cooperative prevention and education and technical experience. Structural fire protection [during a wildfire] in the wildland urban interface is [largely] the responsibility of Tribal, state, and local governments" (USFS 2001). Property owners share a responsibility to protect their residences and businesses and minimize fire danger by creating defensible areas around them and taking other measures to minimize the fire risks to their structures (USFS 2001). With treatment, a wildland-urban interface can provide firefighters a defensible area from which to suppress wildland fires or defend communities. In addition, a wildland urban interface that is properly thinned will be less likely to sustain a crown fire that enters or originates within it (Norton 2002).

By reducing hazardous fuel loads, ladder fuels, and tree densities, and creating new and reinforcing defensible space, landowners would protect the wildland-urban interface, the biological resources of the management area, and adjacent property owners by:

- minimizing the potential of high-severity ground or crown fires entering or leaving the area;
- reducing the potential for firebrands (embers carried by the wind in front of the wildfire) impacting the WUI. Research indicates that flying sparks and embers (firebrands) from a crown fire can ignite additional wildfires as far as 1¼ miles away during periods of extreme fire weather and fire behavior (McCoy *et al.* 2001);
- improving defensible space in the immediate areas for suppression efforts in the event of wildland fire.

Four wildland/urban conditions have been identified for use in the wildland urban interface (Federal Register – a part of the Legislation defining HFRA). These include the Interface Condition, Intermix Condition, Occluded Condition, and Rural Condition. Descriptions of each are as follows (Federal Register 66(3), January 4, 2001):

- **Interface Condition** – a situation where structures abut wildland fuels. There is a clear line of demarcation between the structures and the wildland fuels along roads or back fences. The development density for an interface condition is usually 3+ structures per acre;

- **Intermix Condition** – a situation where structures are scattered throughout a wildland area. There is no clear line of demarcation, the wildland fuels are continuous outside of and within the developed area. The development density in the intermix ranges from structures very close together to one structure per 40 acres;
- **Occluded Condition** – a situation, normally within a city, where structures abut an island of wildland fuels (park or open space). There is a clear line of demarcation between the structures and the wildland fuels along roads and fences. The development density for an occluded condition is usually similar to that found in the interface condition and the occluded area is usually less than 1,000 acres in size; and
- **Rural Condition** – a situation where the scattered small clusters of structures (ranches, farms, resorts, or summer cabins) are exposed to wildland fuels. There may be miles between these clusters.

In addition to these Federal Register defined WUI categories, Northwest Management, Inc., working with over 30 counties and reservations in the west, have identified additional categories to compliment those listed above:

- **High Density Urban** – those areas generally identified by the population density consistent with the location of incorporated cities, however, the boundary is not necessarily set by the location of city boundaries: it is set by very high population densities (more than 7-10 structures per acre or more). Many counties and reservations in the west do not have high density urban areas. Examples of counties with a high density urban classification include in Idaho: Canyon County (Nampa, Caldwell), Ada County (Boise, Meridian, Star, Eagle), and Kootenai County (Coeur d'Alene). In Montana an example of an area with a high density urban classification is Yellowstone County (Billings and Laurel).
- **Infrastructure WUI** – those locations where critical and identified infrastructure are located outside of populated regions and may include high tension power line corridors, critical escape or primary access corridors, municipal watersheds, areas immediately adjacent to facilities in the wildland such as radio repeater towers or fire lookouts. These are identified by county or reservation level planning committees.
- **Wildland Condition** - a situation where the above definitions do not apply because of a lack of structures in an area or the absence of critical infrastructure crossing these unpopulated regions.

In order to arrive at these definitions, Geographical Information Systems processing is necessary. The locations of structures within a county or reservation are mapped to include structures up to 3 miles beyond the border of the county or reservation. In some counties this involves locating structures from ortho photography, aerial photography, or satellite imagery. Where counties have enhanced 911 service, a rural address database has been created and will serve as the basis on which to build the WUI GIS layer. The more detailed information is garnered from digital ortho-photos at a resolution of 1 meter. For those areas not covered by 1 meter DOQQ images, SPOT satellite imagery

at a resolution of 2 meters has been used. These records are augmented with data collected on hand-held GPS receivers to record the location of structures, especially in areas where new housing developments were seen (built after photography has been taken) or under heavy tree canopies.

All structures are represented by a “dot” on the map. No differentiation is made between a garage and a home or a business and a storage building. Counties with a rural addressing map include only the structures with an address assigned by the county, therefore garages and outbuildings are not included in the dataset.

By evaluating this structure density, we can define WUI areas on maps by using mathematical formulae and population density indexes (within the GIS framework) to define the WUI based on where structures are located. The resulting ***population density indexes*** create concentric circles showing high density urban (where they exist), high density WUI areas of Interface and Intermix WUI, as well as Rural WUI (as defined in the Federal Register). This portion of the analysis allows us to “see” where the highest concentrations of structures are located in reference to high risk landscapes, limiting infrastructure, and other points of concern. These analyses do not buffer at a fixed distance from structures, they represent the density of structures within the county or reservation area and therefore represent unique, logically defined graphical representations of WUI areas based on this density.

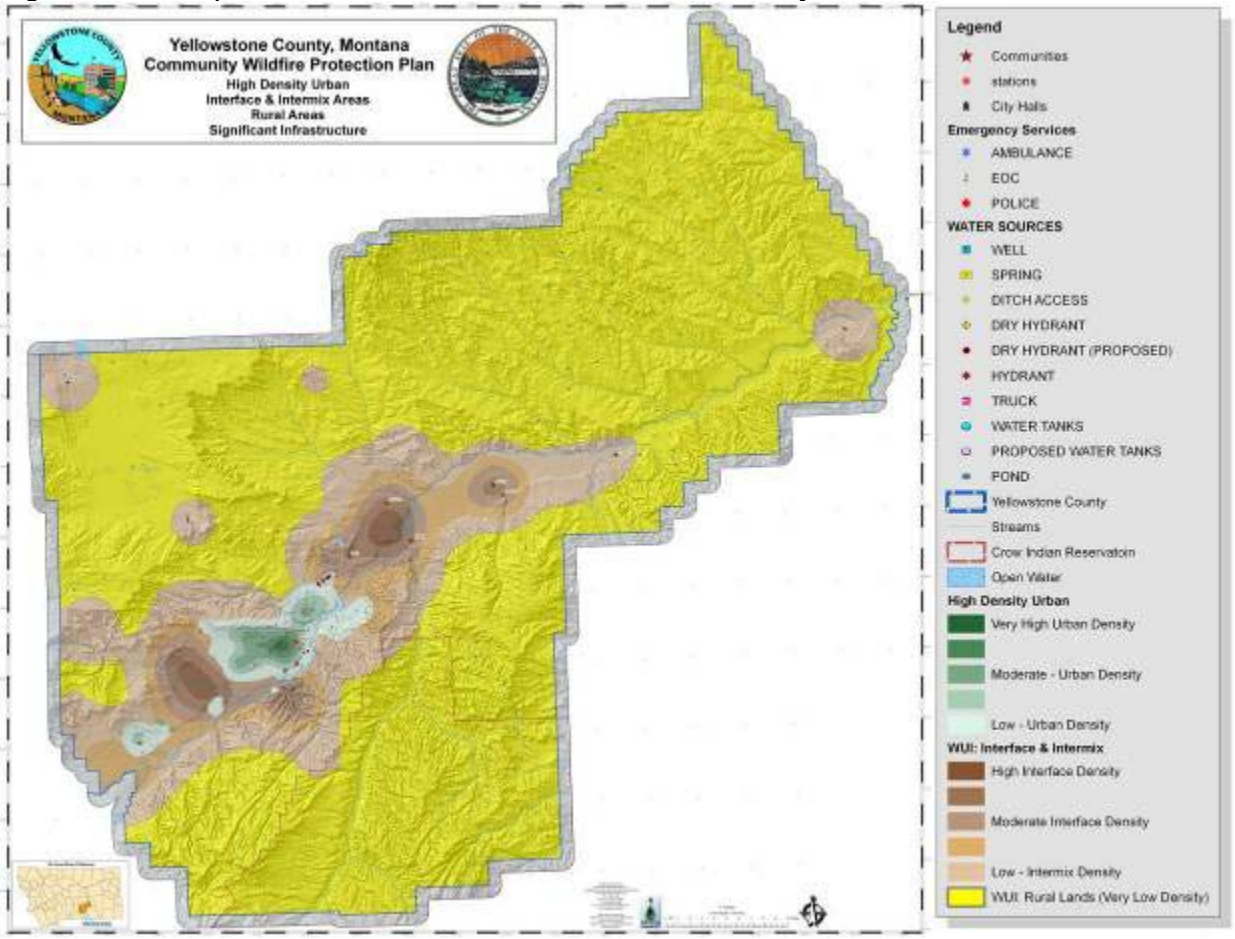
1.2.2 Infrastructure

Mitigation Committees augment these population density maps with the identification of critical infrastructure (defined above) and map corridors (power lines, access routes), islands of protection (radio repeaters), and management areas (municipal watersheds) to protect these areas as part of an integrated approach to mitigation.

All Counties have both significant infrastructure and unique ecosystems within their boundaries. Of note for WUI Wildfire Mitigation Plans is the existence of highway routes and the presence of high tension power lines supplying surrounding counties. Many counties are also served by railroads. These resources are considered in the protection of infrastructural resources of the region and the state.

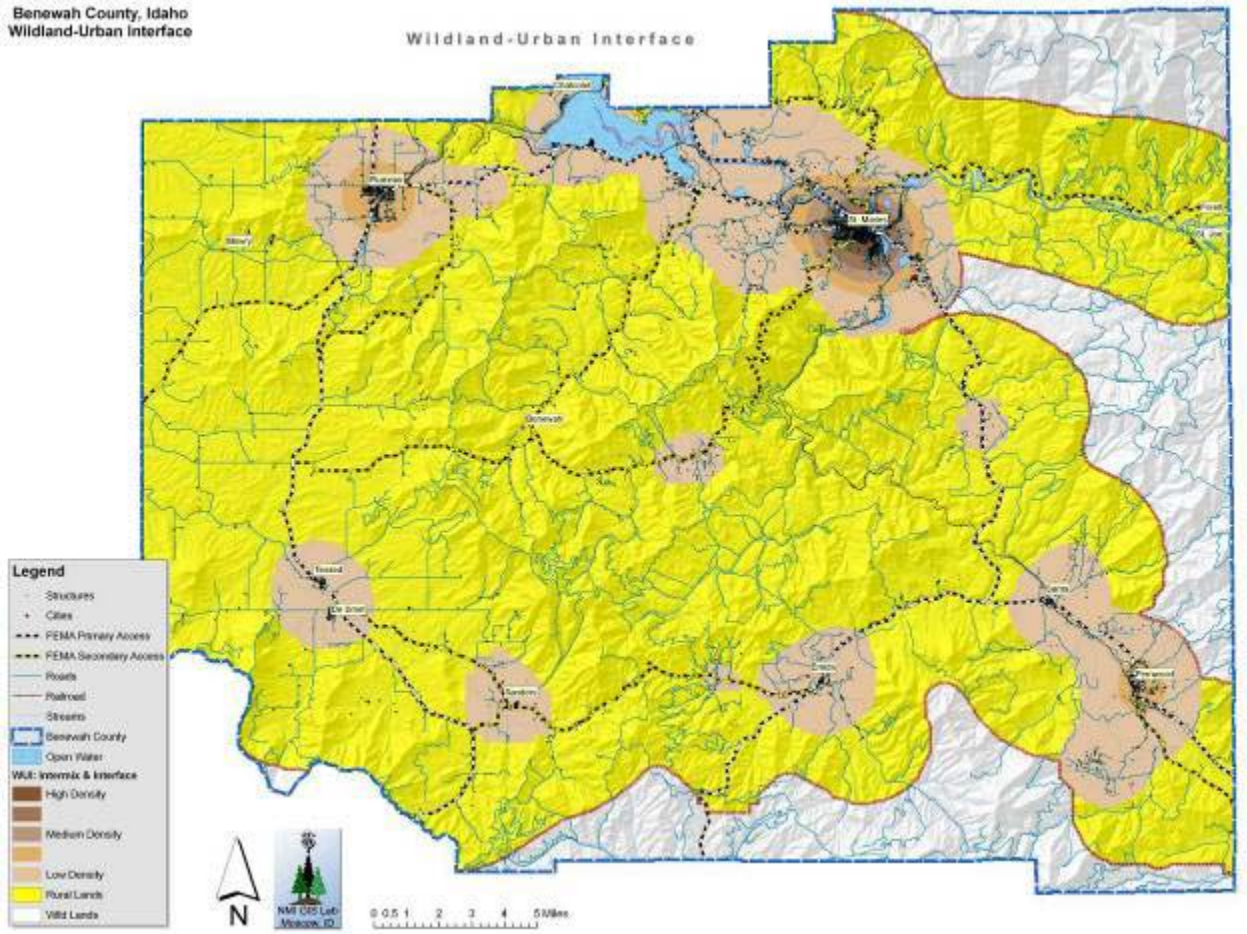
Protection of high tension power lines from loss during a wildfire is paramount in as much as the electrical power they provide serves not only the communities of one county, but of surrounding counties. The protection of these lines allows for community sustainability, support of the economic viability of each county, and the protection of people who rely on that power. Fuels mitigation under and adjacent to power lines has received considerable attention in forested ecosystems as timber is thinned and heavy accumulations of brush are managed. However, the importance of management of rangeland ecosystems under high tension power lines should not be overlooked. Brush intermixed with grasses and other species, during extreme fire weather events, coupled with steep slopes, can produce considerable heat and particulate matter. When this occurs under power lines, the result can be arching between lines and even failure of the electrical media itself.

Figure 1. Example of WUI defined for Yellowstone County, Montana.



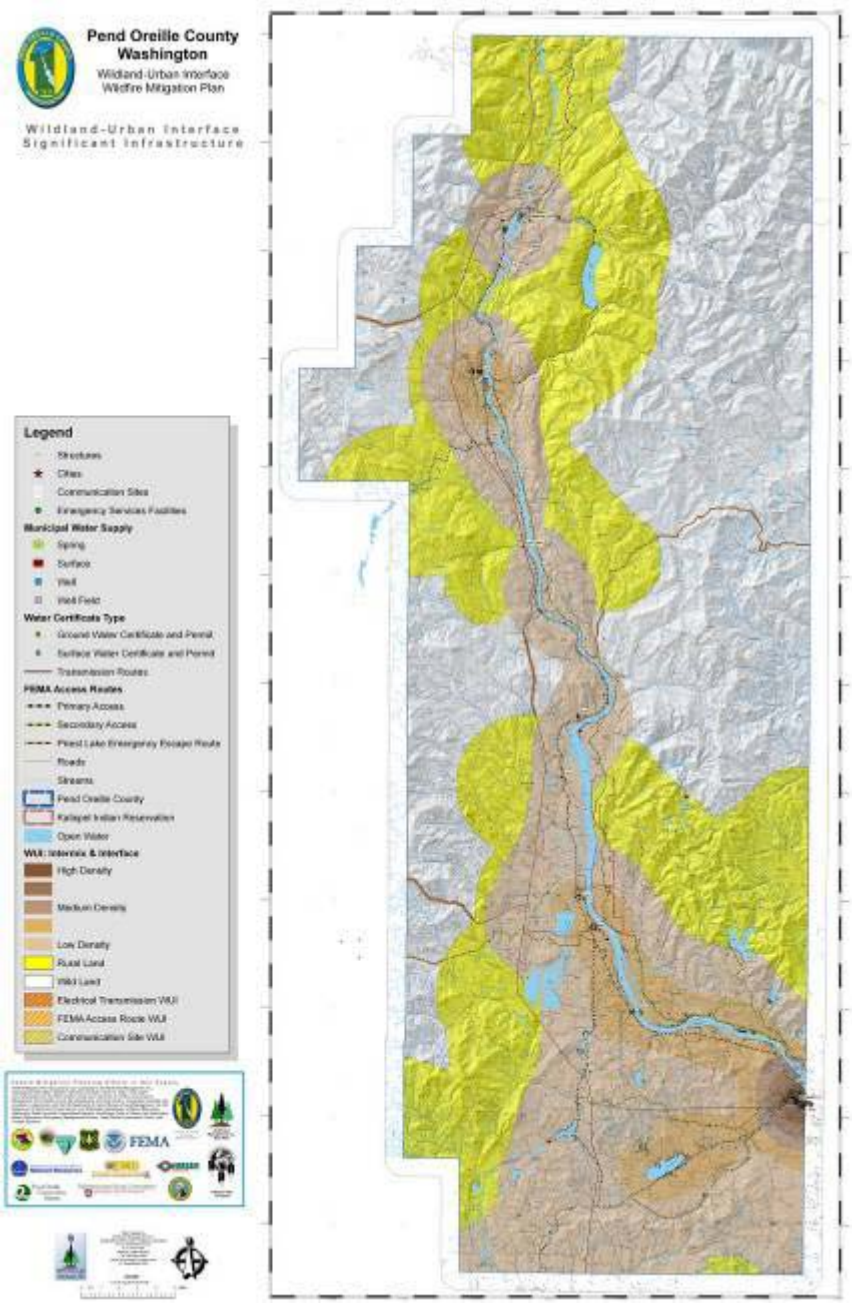
Notice the greenish polygons in the south central portions of the county; these are the High Density Urban areas of Billings and Laurel. The shades of brown indicate WUI definitions consistent with Interface and Intermix areas with the darker browns indicating higher structure density than lighter brown colored areas. The yellow areas on this map indicate Rural structure densities. Notice there are no wildlands identified in Yellowstone County. Ranches and farm houses are scattered throughout the rural lands. The Crow Indian Reservation is located in the southeast corner of Yellowstone County.

Figure 2. Example of WUI defined for Benewah County, Idaho.



In Benewah County there are no High Density Urban areas. The highest densities are consistent with Interface designations and are found in and around the cities of St. Maries, Plummer, and Fernwood. Intermix areas (lighter browns) are found around communities such as Tensed, De Smet, Sanders, and Emida. Also notice unnamed communities scattered around the county where population densities are consistent with the Intermix designation. By using a structure density definition as opposed to named communities only, the planning committees have been able to locate and identify clusters of structures resulting from the building of subdivisions and other population growth trends. The areas colored in white are the wildlands of Benewah County where little or no structures are located.

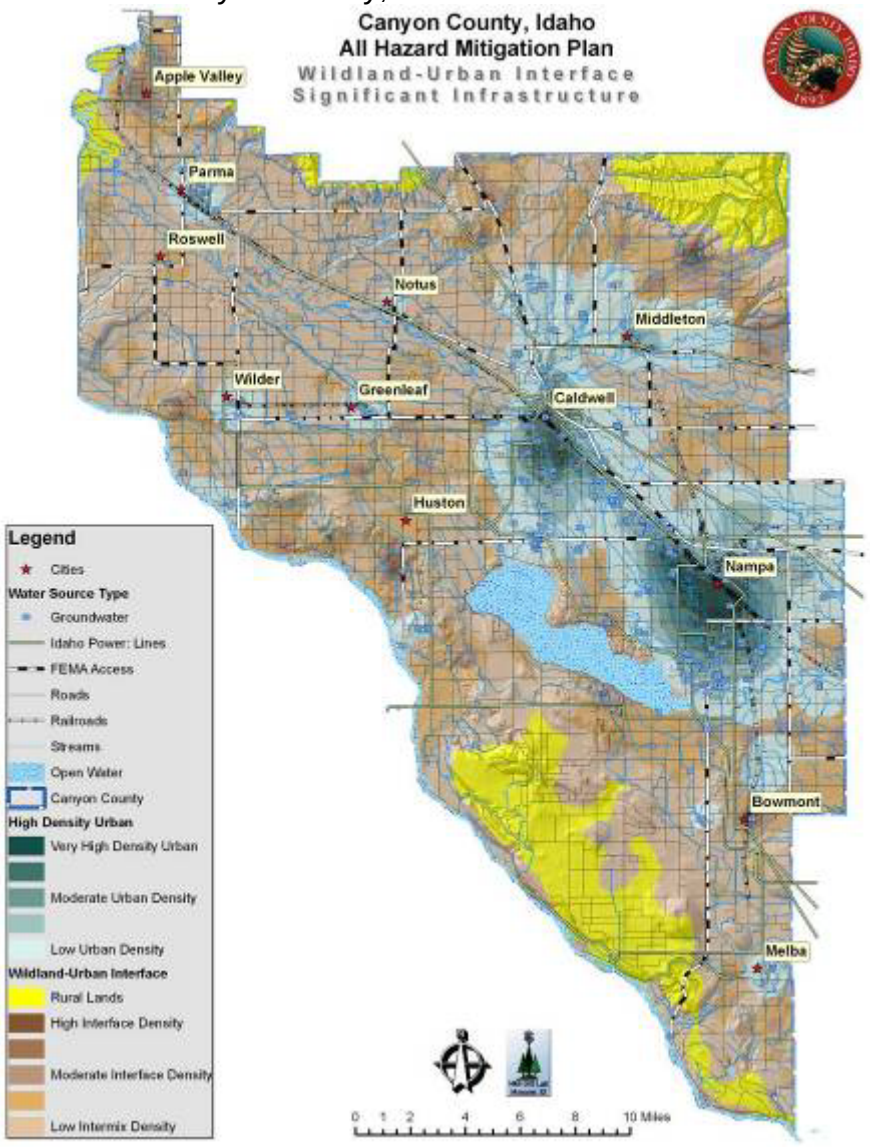
Figure 3. Example of WUI defined for Pend Oreille County, Washington.



Pend Oreille County, WA, located in the extreme northeast corner of Washington State has no High Density Urban areas identified. The highest population densities are consistent with Interface Conditions in the city of Newport (southeast region of the county). Most of the houses in the county are located in the southern portions of the county and along the Pend Oreille River (runs north from Newport to Canada border). Most of these populated places have a structure density consistent with an Intermix condition, with higher densities (shown with darker browns) around Usk and Ione. Rural population densities surround most of the Intermix and Interface areas and are colored yellow on the map. The white areas are consistent with the wildlands designation. The reader may notice WUI power line corridors crossing the wildlands along the western edge of the county (from Ione west and from Usk west). There is also a Priest Lake Emergency Evacuation Route from Ruby (center of map) eastward to the Idaho border which has been designated as part of the Pend Oreille County WUI. Scattered across the wildlands are radio repeater with "Communication Site WUI" areas defined (not visible at this scale). All of these components were identified by the Interface Planning Committee convened to develop the Community Wildfire Protection Plan (CWPP) for Pend Oreille County. This is the WUI adopted by the County for HFRA and NFP purposes.

Figure 4. Example of WUI defined for Canyon County, Idaho.

Canyon County is an area with a very large population base in the cities of Nampa, Caldwell, and Middleton. This High Density Urban configuration extends eastward into Ada County with cities including Boise. However, the population density in some of Canyon County's smaller incorporated cities was found to be similar to the metropolis of Nampa and Caldwell. These include Parma, Wilder, Notus, Greenleaf, and Melba. Areas not a part of formal city limits (between Bowmont and Nampa) were also found to be supporting high density urban population densities. The brown shaded areas of Canyon County represent the Intermix and Interface condition areas of the County, while the yellow represents the rural lands of this area. There are no wildlands in Canyon County as defined by the Canyon County Interface Planning Committee.



About the Author:

Dr. William E. Schlosser is the Technical Services Department Manager at Northwest Management, Inc., located in Moscow, Idaho. He is also the Director of the Northwest Management Geographic Information Systems Laboratory. The team of resource professionals at Northwest Management, Inc., works with Counties and Indian Reservations across the western US to complete hazard mitigation planning consistent with the Healthy Forests Restoration Act, the National Fire Plan, and the Federal Emergency Management Agency (FEMA) for pre-disaster mitigation planning. The analysis defined in this short paper has been developed within the Northwest Management team of professionals and with over 30 counties and Indian reservations in 5 states.

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